Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

A CIRCUM-INSULAR PALÆOZOIC FAUNA.

CONTENTS.

Introduction.
Zoölogical Provinces of Devonian Time.
Distribution of Land and Water during Devonian Time.
Union of Eastern and Western Devonian Provinces.
Generic Evidence of the Origin of the Littoral Fauna about the Ozark Island.
Specific Evidence of the Origin of the Littoral Fauna about the Ozark Island.
Conclusion.

INTRODUCTION.

Zoölogists who have turned their attention to the geographic distribution of animal life on the earth at the present time, have divided it into numerous zoölogical provinces. The marine zoölogical provinces are separated by three classes of barriers, (1) Climatic, (2) Land, (3) Abyssmal. Each one of these establishes a limit to the migrations of marine life. There is no reason to doubt the existence of zoölogical provinces in past time similar to those existing today, with the same sorts of barriers, but ever changing with the progress of time.

These zoölogical provinces of past time give rise to problems with which the palæontologic geologist has to deal. Unfortunately the ancient barriers are obscured or lost, being buried by later formations, or the sea, or carried away by erosion, and it falls to the investigator to reconstruct the barriers from a study of the faunas and of the stratigraphy.

Zoölogical provinces of Devonian time.—During Silurian time the faunas of eastern North America and northern Europe were intimately related. Many species were common to both regions, and there seems to have been freedom for intermigration between the two. With the beginning of Devonian time these two regions became isolated. The faunas in each continued their evolution, but each in accordance with the conditions of its own environment. At the period of deposition of the Hamilton beds in New York, a distinct fauna had to come to exist in each of these two areas.

The east American fauna of this time has been described and illustrated chiefly in the various reports of the New York state geologist. From studies of the South American Devonian fauna, chiefly those of Dr. A. Ulrich,[1] it has been shown that the east American Middle Devonian fauna is related to the South American fauna. The peculiar genera *Tropidoleptus* and *Vitulina* are characteristic of these two regions, being unknown in the European and west American Devonian faunas. Besides these genera, there are other bonds of relationship between the faunas. This east American fauna inhabited an area bounded on the north by the nucleus of the North American continent and on the east by the land area lying at that time to the east of the present Appalachian region. It did not extend westward beyond the Mississippi River. From its relationship to the South American faunas, we may conclude that it extended far to the south.

The contemporaneous European fauna was largely developed in central Europe, in the Ural Mountain region, and extended across Asia and into the western part of North America. In America its most typical development was in the far northwest. It was first described by Meek[2] from the Mackenzie River basin, and has lately been much more completely described by Whiteaves.[3] It extends southeastwardly, and, in the so-called Hamilton of Iowa, it reached the Mississippi River.

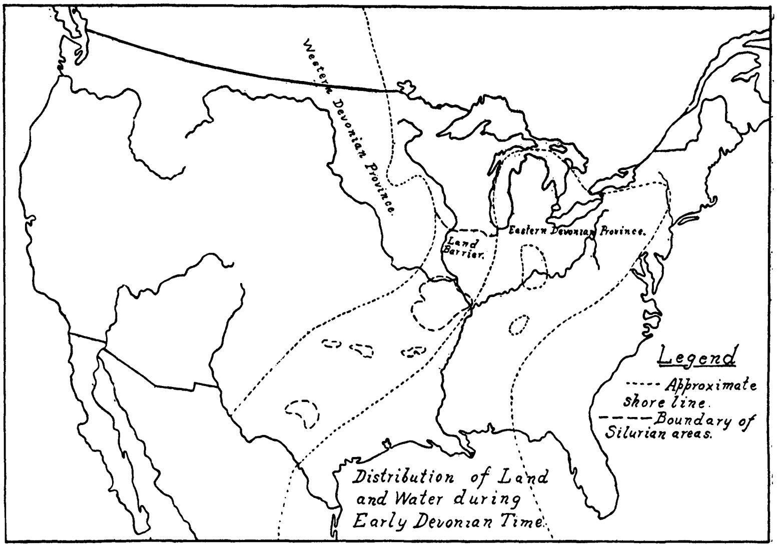
Distribution of land and water during Devonian time.— In seeking for the barrier, which must have existed during the greater part of Devonian time, near the present location of the Mississippi River, the presence of a land barrier seems to be necessarily presupposed. The stratigraphy of the region admits of this conclusion. Along the southern border of the Silurian peninsula, extending southward and including a large part of

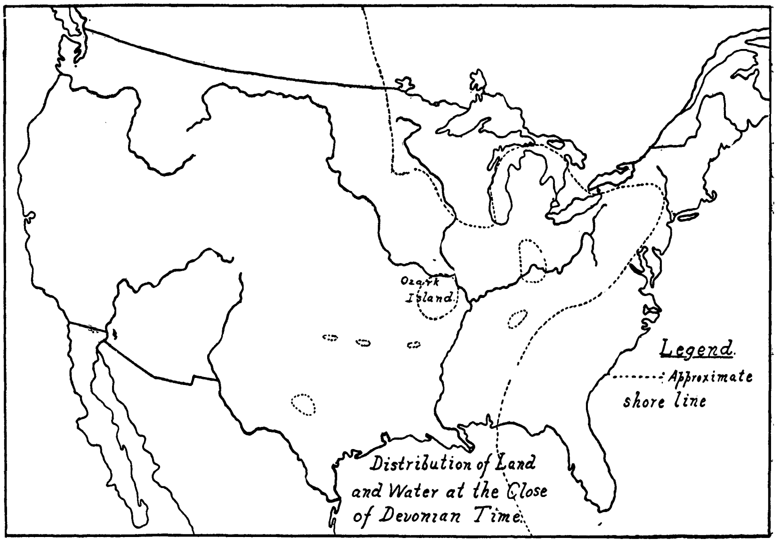
---

[1] Beiträge zur Geol. und Pal. von Südamerika, I, Paläozoische Versteinerungen aus Bolivien.

[2] Trans. Chic. Acad. Sci., Vol. I. (1868).

[3] Cont. to Canadian Pal., Vol. I., Part III. (1891).


Western Devonian Province.
Eastern Devonian Province.
Land Barrier.
Legend
----- Approximate shore line.
------ Boundary of Silurian areas.
Distribution of Land and Water during Early Devonian Time.


Ozark Island.
Legend.
······· Approximate shore line
Distribution of Land and Water at the Close of Devonian Time.

Wisconsin and the northern portion of Illinois, rocks of much younger age lie upon the Silurian beds, indicating that during a long period between Silurian and Carboniferous time this peninsula extended far to the south. The Ozark Silurian or Ordovician region has also lying upon its flanks rocks of much younger age, indicating that during the greater part of Devonian time it was a body of dry land of more than the present extent of the older rocks. There seems to be good reason, therefore, to suppose that during this period the Wisconsin peninsula and the Ozark Island were joined. This, however, would not alone form a sufficient barrier to separate the two faunas, as they could easily migrate around the southern end of this peninsula. There are, however, small patches of Silurian rocks exposed in Arkansas, Indian Territory and Texas, and all of these are surrounded in a similar way by rocks of much younger age, and this suggests the probable extension of this land barrier far to the southwest. Furthermore, the presence in the east American Devonian fauna of representatives from the South American province necessitates a shore line along which the migration could have taken place. This suggests the extension of this land into South America. With the existence of such a land tract the separation of the two Devonian faunas would be effectual.

If the conclusions of the last paragraph are correct, the Ozark region was not an island during earlier Devonian time, but was included in a long peninsular extension of the ancient northeastern land, or more probably in an isthmus joining it to some larger body lying to the southwest. By a partial submergence of this peninsula or isthmus the Ozark Island was formed. The depression of this land area was neither sudden nor continuous, but the movements were oscillatory in their nature.

Union of eastern and western Devonian provinces.—The earliest evidence of the union of the two seas on either side of this narrow strip of land is found in the appearance of an entirely foreign fauna in the midst of the Hamilton beds of New York. This is the Cuboides fauna of the Tully Limestone. From a study of this fauna Professor Williams[1] has shown that it was not the genetic successor of the fauna immediately preceding it, but that it was entirely foreign to the area, and that its relationships were with the Devonian faunas of western and northwestern America, which in turn were intimately related to the European middle Devonian faunas.

This earliest submergence of the Ozark Isthmus was not permanent. The two seas were not in communication for a sufficient period to admit of any extensive intermigration of the faunas. A colony from the west escaped into the east and found its way into the New York region, where it occurs in the Tully limestone. From the oscillatory natures of the movements of this region during its period of submergence, there is reason to expect that there will be found in the Devonian beds along the border line between the eastern and western provinces a mingling of the two faunas. This need not necessarily occur in the same beds at first; the faunas might appear in alternate layers. Much yet remains to be done, however, upon the details of the stratigraphy and palæontology of this region. None of the present records enter into sufficient detail to be available for a conclusive study of the subject.

On the final submergence of the connecting tracts and the formation of the Ozark Island—having approximately the area of the present exposure of the older rocks — the faunas of the two provinces had an unlimited opportunity to intermingle. It is this circum-insular fauna, found embedded in the strata of the Chouteau group,[2] which is the subject of chief consideration in this paper.

The study of island faunas has always possessed the greatest interest to evolutionists. In his observations upon island faunas during his trip around the world, Darwin found many of the facts which led to his proposal of the theory of natural selection.

---

[1] Bull. Geol. Soc. Am., Vol. I, pp. 481–500 (1890).

[2] The author may be criticised by some for using the name Chouteau, for these beds have of late come to be generally considered as contemporaneous with the Kinderhook, and designated by that name, which was applied at an earlier date. There is no doubt in the author's mind of the contemporaneity of the Kinderhook and Chouteau, but the latter term is used as a convenient discriminative formation name of a local nature to designate the beds deposited on the immediate shores of the Ozark

The studies of Wallace have elevated island life into a distinct field of investigation. In the study of an island fauna, whose records, and even the island itself, are buried in the rocks, the task of interpretation becomes especially difficult. The conclusions to which one may arrive, however, equal in importance those reached in the study of recent island faunas. The study of the littoral faunas has much the same nature and importance as that of the islands themselves. So far as the writer is aware, however, there never has been published the results of a special study of a circum-insular fauna of palæozoic time.

In the detailed study of any fossil fauna the palæontologist must ask himself of each individual genus and species, is this an evolution form, or is it a migration form? Every genus or species, in whatever geologic or geographic position it may be found, falls into one of these two categories. Either its ancestors have lived in the same geographic area where it exists, or they lived in some other part of the world, and the genus or species is in the particular position where it is found, through migration from the original center of evolution. This migration may have occupied a series of generations. Very often these questions cannot be answered, but in most cases an answer can be found for those forms which give character to the fauna.

From the nature of the case the fauna of the Chouteau group was composed necessarily of migration species. An area of land had become sea-bottom, having no preëxisting marine fauna, it had to be peopled, if peopled at all, by organisms which come in from without. This does not, however, make it necessary that the migration should have been a distant one. On a critical examination of the fauna it is found that the ancestry of the individual genera and species can be traced back to two different sources. These are the middle and lower Devonian faunas of the East and the Devonian fauna of Europe and the West.

Generic evidence of the origin of the littoral fauna about the Ozark

Island. The typical Kinderhook beds were deposited nearer the shore of the mainland of that time and under somewhat different conditions, and it might be misleading to use the term in this connection. It is only the circum-insular fauna as found in the Chouteau beds that is considered here.

Island.— In the following table all the genera occurring in the Chouteau group are tabulated with their geologic range[1] and geographic distribution, and from this table the generic evidence of the origin of the fauna may be seen.

	Chouteau Group	East American Devonian Province	West American and European Devonian Province.	American Silurian	European Silurian
BRACHIOPODA.					
Athyris	x	x	x	x	x
Camarophoria	x		x		
Chonetes	x	x	x	x	x
Cyrtina	x	x	x	x	x
Leptæna	x	x	x	x	x
Lingula	x	x	x	x	x
Orthothetes	x	x	x	x	x
Productella	x	x	x		
Productus	x				
Ptychospira	x		x		
Rhipidomella	x	x	x	x	x
Pugnax	x		x		
Rhynchonella	x	x	x	x	x
Schizophoria	x	x	x	x	?
Spirifer	x	x	x	x	x
LAMELLIBRANCHIATA.					
Aviculopecten	x	x			
Cardiopsis	x	x			
Edmondia	x	x			
Entolium	x				
Grammysia	x	x	x	x	
Pernopecten	x				
Promacrus	x				
Pterinea	x	x		x	
Sphenotus	x	x			
GASTEROPODA.					
Bellerophon	x	x	x	x	x
Eccyliomphalus	x	x	x	x	x
Euomphalus	x	x	x	x	x
Loxonema	x	x	x	x	x
Platyceras	x	x	x	x	x
Porcellia	x	x	x		x
Straparollus	x	x			
CEPHALOPODA.					
Goniatites	x	x	x		
Nautilus	x	x	x	x	x
Orthoceras	x	x	x	x	x

---

[1] The range of the genera above the Chouteau group is not tabulated. In a future paper, now in preparation, the history of the faunas of the overlying Osage group will be considered.

	Chouteau Group	East American Devonian Province	West American and European Devonian Province	American Silurian	European Silurian
PTEROPODA.					
Conularia	x	x	x	x	x
Hyolithes	x	x	x	x	x
CRINOIDEA.					
Agaricocrinus	x				
Amphoracrinus	x				
Cyathocrinus	x	x	x	x	x
Dorycrinus	x		x		
Gennaeocrinus	x	x			
Platycrinus	x	x			
Scaphiocrinus	x	x			
Schizoblastus	x				
CORALS.					
Amplexus	x	x	x	x	?
Chonophyllum	x	x	x	x	x
Cyathophyllum	x	x	x	x	x
Leptopora	x				
Lithostrotion	x				
Michelinia	x	x			
Microcyclus	x	x	x		
Palæacis	x				
Syringopora	x	x	x	x	x
Zaphrentis	x	x	x	x	x
TRILOBITA.					
Brachymetopsis	x				
Phillipsia	x		x		
Proetus	x	x	x	x	x

In the foregoing table it is seen that the genera, exclusive of those peculiar to the Chouteau, with but three exceptions, may be divided into three groups. (1) Those common to the Chouteau and the east American faunas. (2) Those common to the Chouteau and the west American or European faunas. (3) Those common to all these faunas. It is important to observe that the genera of the last class are all older than those peculiar to only one of the two Middle Devonian provinces. As shown in the table they extend back into the Silurian time when the two areas were united. After the isolation of the two regions as distinct Devonian provinces, new genera originated, and those thus originating in the separate provinces were different.

The exceptions to this rule are: *Productella*, *Goniatites* and *Microcyclus*. The fact of the recorded distribution of *Productella* points either to a dual origin of the genus, or to an imperfection in the record, or, possibly to an exceptional migration across or around the barrier in spite of the general effectiveness. The name *Goniatites* is applied to a heterogeneous assemblage of forms, which have been divided into numerous genera by Hyatt and other recent writers, and if the Chouteau species were referred to these more limited divisions, it is probable that they would not appear as exceptions. *Microcyclus* occurs in the Devonian fauna at Devil's Bake Oven in southern Illinois, where the eastern faunas approach nearest geographically to those of the west. It is possible that this fauna lived during the period of submergence of the land barrier, and that *Microcyclus* in this locality is really a representative of the western and not of the eastern fauna.

Taking the generic evidence as a whole, it points to the dual origin of the fauna.

Specific evidence of the origin of the littoral fauna about the Ozark Island.—In the consideration of the specific evidence of the origin of the Chouteau fauna each species has been studied with special reference to its evolution from preëxisting species. As might be expected, the evolution of the species can be traced in only a few instances comparatively, but this evidence also, so far as it is available, points to the dual origin of the fauna. Each of the species whose evolution can be traced will be briefly considered.

Athyris hannibalenis, Swallow. This species is not uncommon in the yellow Chouteau Limestone. It most closely resembles *A. lamellosa*, L'Eveille, of the succeeding beds. It is generally less transverse than that species, though this character is variable, and individual specimens may be found which are quite equal to *A. lamellosa* in this respect. The concentric lamellæ on the exterior of the shell are somewhat closer together than in *A. lamellosa* from the Burlington Limestone. It is intermediate in its characters between *A. spiriferoides*, Eaton, of the New

York Hamilton beds, and *A. lamellosa*, of the Burlington Limestone, though it approaches much closer to *A. lamellosa* than to *A. spiriferoides*. A well-preserved exfoliated specimen from the Chouteau limestone near Springfield, Mo., closely resembles a specimen of *A. spiriferoides*, which is in the same condition of preservation, from the black calcareous layers of the Hamilton series of New York.

Athyris proutii, Swallow. Though this species has never been figured, it is well characterized and easy of recognition. Specimens have been examined from the typical locality, and compared with those from the base of the Chouteau group, near Springfield, Mo., they cannot be separated. The species is not apt to be confused with any other American form, but it is similar to and possibly identical with *A. reticulata*, Gosselet,[1] of the Middle Devonian of Europe. American specimens agree closely with Tschernyschew's[2] figures of this species from the Ural Mountains, and the surface ornamentation of the American form is identical with the European.

Leptæna rhomboidalis, Wilckins. This cosmopolitan species is one of the most interesting in the whole fauna. It occurs in all the beds of the Chouteau group and extends up into the Burlington Limestone. In studying its geographic and geologic distribution, it is found not to be recorded in the Devonian fauna of the west, though it does occur in Europe. It occurs abundantly, however, in the Lower and Middle Devonian faunas east of the Mississippi River. Its origin in the Chouteau fauna may probably be traced to the eastern Hamilton fauna.

Orthis (*Rhipidomella*) *michelini*. L'Eveille. Although the subgenus *Rhipidomella* is present in the European Devonian faunas, it does not occur in those of northwestern America. The form from which *R. michelini* has its origin is *R. vanuxemi*, Hall, of the eastern Hamilton beds. Indeed, it is most doubtful whether the two forms should be separated at all. Oftentimes individual specimens from the Chouteau beds cannot be distinguished from individual specimens from the New York Hamilton beds, except in color, the form being essentially the same. The presence of this form in the Iowa Devonian beds may be attributed to the nearness of that area to the border line between the two provinces during the period of submergence of the land barrier.

---

[1] *Spirigera* (*Athyris*) *reticulata*, GOSSELET, Ann. Soc. Geol. du Nord. Vol. IV., p. 312, Pl. III., Figs. 3 a–f (1887). *Spirigera reticulata*, GOSSELET Equisse Geol. du Nord de la France; Pl. VI., Fig. 6 (1880).

[2] *Athyris reticulata*, Tschernyschew, Die Fauna des Mitt. und Ober Devon am des W. Abhange des Urals., p. 57, Tab. X, Figs. 16 a–d (1887).

Orthis (*Schizophoria*) *resupinata*, Martin. American specimens of this species have been described as *O. swallovi*, Hall,[1] but it is impossible to separate the American specimens from European examples. The ancestor of this species is most certainly to be found in *O. striatula*, Schl. of the European Middle Devonian. In the beds of the Chouteau group many intermediate forms between the two species are found. The facts of the distribution of *O. striatula* are most interesting. It occurs in the Western American Devonian faunas under the name *O. iowensis*, Hall. In the eastern portion of America it appears first in the Tully Limestone under the name of *O. tulliensis*, Vanuxem. This represents its first eastward migration. Later, when the land barrier was more fully removed, it again migrated to the east, and is found in the Chemung faunas under the name *O. impressa*, Hall.

Productella hallana, Walcott (= *P. dissimilis*, Hall). This peculiar little species occurs abundantly in the Devonian fauna of the west and in Europe, and is also present in the very lowest beds of the Chouteau group near Springfield, Mo. It is also present in the very lowest beds of the Chemung group in New York.

Productella pyxidata, Hall. This species is closely related to *P. subaculeata*, Murch., of the European Devonian, and its ancestry may apparently be traced to that species.

Rynchonella (*Pugnax*) *acuminata*, Martin. This type of Rynchonella is wholly unknown in the east American province until after the period of immigration from the west, when it occurs with *Productella hallana*, in the very lowest beds of the Chemung group in New York. It also occurs, as does *P. hallana* in the lowest beds of the Chouteau group.

---

[1] Geol. Surv. Iowa, Vol. I., Pt. II., p. 579, Pl. XII., Figs. 5 a–b (1858).

Spirifer cf. compactus, Meek. A common species in the Chouteau beds, is remarkably like Meek's illustrations of *S. compactus*[1] from the Mackenzie Valley. If not referable to that species it can most certainly be considered as its genetic successor.

Spirifer marionensis, Shumard. This is one of the most characteristic of Chouteau species. The form to which it is most closely related, through *S. Whitneyi*, Hall, of the Iowa Devonian, is *S. verneuili*, Murch. Some of the variations of this most variable species[2] are closely similar to individual specimens of the American *S. marionensis*.

Eccyliomphalus paradoxus, Winchell. The nearest ally and probable genetic predecessor is found in *E. laxus*, Hall, from the Devonian of the east.

Loxonena cf. hamiltonae, Hall. In beds of the Chouteau group near Springfield, Mo., is a little species of *Loxonema* which can scarcely be separated specifically from this species of the New York Hamilton beds.

Conclusion. From a consideration of all the evidence, the fauna of the Chouteau group is seen to be the resultant of the union of the two distinct faunas. Each of the original faunas is undoubtedly Devonian, but the resultant fauna as a whole has the strongest Carboniferous affinities. Before the removal of the barrier which kept them apart, these two faunas had lived under similar physical environments, and it is probable that either of them could have lived alone on the shores of the Ozark Island without undergoing any considerable change. But on the intermingling of two such distinct faunas, a fierce struggle for existence arose between them. In this struggle the most hardy elements of the two hardy faunas survived, and in their union resulted a most vigorous fauna which gave character to succeeding faunas for a long period of time, and whose influence was far reaching.[1] Many species became extinct and many new ones were initiated, while several genera appear here for the first time. The most important of these new genera is *Productus*, which attained at its period of initiation almost its complete range of primary differentiation. In the Chouteau Limestone occur species of this genus which represent the three subdivisions, including the greater number of all its known species, *i. e.*, the groups of *P. semireticulatus*, *P. cora* and *P. punctatus*. The genus *Productus* is one of the most characteristic of Carboniferous time.

---

[1] Trans. Chicago Acad. Sci. Vol. I., p. 102 (1868).

[2] Etude sur les variations du *Spirifer vermeuili*, par J. Gosselett Mem. Soc. Geol. du Nord. (France) Tome IV., I., pp. 1–61, plates I.–VII. (1894).

It is of interest and value, for purposes of correlation to trace the further migrations of the fauna of the West Devonian province. When the land barrier was permanently removed, one detachment migrated eastward into New York and gave origin to the faunas of the Chemung epoch. In the Chemung fauna the same two elements exist as in the Chouteau fauna, but the western and European element is so much in the ascendancy, that the fauna has a very different aspect. It seems that the foreign fauna was much better adapted to the conditions of environment than the native one, and so, instead of a general mixture of the two, such as took place on the shores of the Ozark Island, the native fauna was driven out by the foreign one, only a small element of it being absorbed.

In the very base of the Chemung[2] are two extremely interesting species, *Rynchonella* (*Pugnax*) *acuminata*, Martin, and *Productella hallana*, Walcott. These same two species also occur in the *base* of the Chouteau group. Both of them, or nearly related species, are abundant in the Devonian beds of the western province. In the eastern province they are unknown, and nothing like them occurs before the immigration of the western fauna. Appearing as they do for the first time after the removal of the land barrier between the east and west, in these two localities, southern Missouri and New York, they furnish good ground upon which to correlate the formations in which they occur in the two regions, making the base of the Chouteau group contemporaneous with the base of the Chemung group of New York.

---

[1] It is not the intention of the author to convey the idea that the fauna of the Mississippian Series originated exclusively on the shores of the Ozark Island. On the shore of the mainland adjoining, the same opportunity for the intermingling of the two faunas existed. The Chouteau fauna is alone treated in the present paper because it is this fauna with which the author is familiar. The whole subject of the origin and evolution of the Mississippian faunas involves a detailed study, not only of the Chouteau and Kinderhook faunas and their successors, but also of the Waverly and Marshall faunas of Ohio and Michigan. It is believed that the key to the whole problem is to be found in the dual origin of the faunas as set forth in the present paper.

[2] On a remarkable Fauna at the base of the Chemung Group in New York. H. S. Williams. Am. Jour. Sci., Vol. XXV., p. 97 (1883). Fauna of the Chemung Beds at High Point. J. M. Clarke. Bull. U. S. G. S. No. 16., p. 72 (1885).

In the early reports, the Chouteau beds were referred to the Chemung group, but at the present time they are generally considered as younger than the Chemung because the fauna as a whole is more nearly related to the succeeding Carboniferous than to any Devonian fauna. Continued investigation seems to substantiate the old view of the Devonian age of the Chouteau beds. While *the Chouteau fauna is not the Chemung fauna*, the two lived contemporaneously. The differences between them are geographic in their nature and origin, rather than chronologic.

The dividing lines between time periods such as are understood by the terms Devonian and Carboniferous must be taken arbitrarily in their closer application, whatever may be the distinctness of the periods from a general point of view. It is incompatible with modern doctrines to conceive of a sudden change through which the Devonian faunas of the world became extinct and the Carboniferous faunas simultaneously initiated. The Carboniferous fauna must have begun to take its origin in Devonian time, in the midst of Devonian faunas. A plane extended around the world between the formations having faunas most closely allied to those below, and the formations whose faunal alliance is upward, would not be a contemporaneous division. If time periods are arbitrarily separated by horizontal time lines, or time planes, of necessity it follows that cases will be observed where faunas with Carboniferous alliance will have lived before the arbitrary Carboniferous-Devonian time line, and faunas with

Devonian alliance will have lived after it.[1] The Chouteau fauna is a good illustration of a fauna with Carboniferous affinities living before the close of Devonian time, as divisions are usually shown.

STUART WELLER.

LABORATORY OF PALÆONTOLOGIC GEOLOGY,
UNIVERSITY OF CHICAGO.

---

[1] An illustration of the persistence of a Devonian fauna is seen in the fauna of the Spring Creek Limestone near Batesville, Ark. See: The Recurrence of Devonian Fossils in Strata of Carboniferous Age. H. S. Williams, Am. Jour. Sci., Vol. XLIX., p. 94 (1895).